INTRODUCTION

Rock pocket mice live in the Sonoran Desert in the southwestern United States and Mexico. Over time, volcanic eruptions affected the environments where the mice live. These eruptions covered parts of the ground in dark volcanic rock.

In this activity, you will explore how this change impacted rock pocket mouse populations. You will make observations, analyze and interpret data, and support claims with evidence. These skills are essential in science and many other fields.

PART 1: How Are Rock Pocket Mouse Populations Different?

Figure 1 shows images of rock pocket mice in different environments. You will use these images to make observations, ask questions, and make predictions.

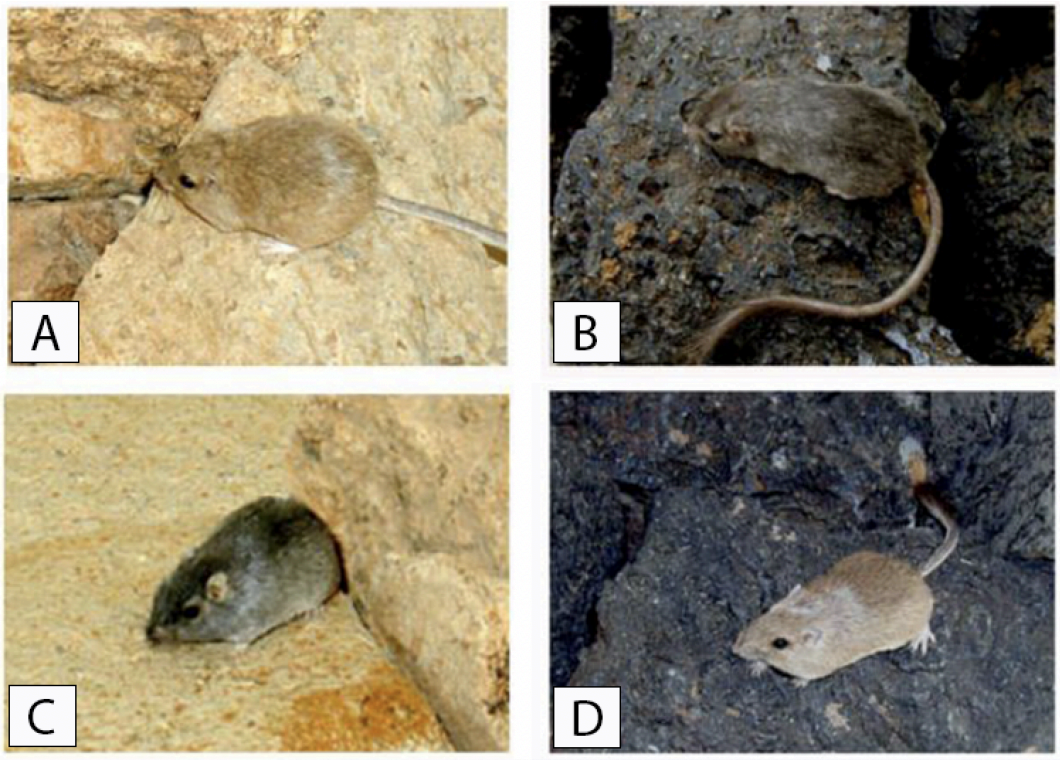

Figure 1. Four different rock pocket mice living in their natural environments.

1. What do you notice about the four images in Figure 1?

The mice on the top two images (A and B) blend into their environment better. The mice on the bottom two images (C and D) stand out in their environment.

2. Predict how likely each mouse is to survive in the environment where they live.
   a. Mouse A:

   Likely to survive

   b. Mouse B:

   Likely to survive

   c. Mouse C:

   Less likely to survive

   d. Mouse D:

   Less likely to survive

3. What type(s) of data would help you explain why these mice have different fur colors?

   The DNA sequencing (genotype) would be helpful to explain the different fur colors.

PART 2: Are There Genetic Differences Between Mice with Different Fur Colors?

A rock pocket mouse's fur color is affected by a protein called **MC1R**, which stands for melanocortin 1 receptor. The MC1R protein is encoded by a gene called ***Mc1r***.

Mc1r gene nucleotide sequence in mice comes from two different populations:

- a population of mostly **light**-colored mice living on light-colored desert rock
- a population of mostly **dark**-colored mice living on the Pinacate lava flow (an area covered by dark volcanic rock)

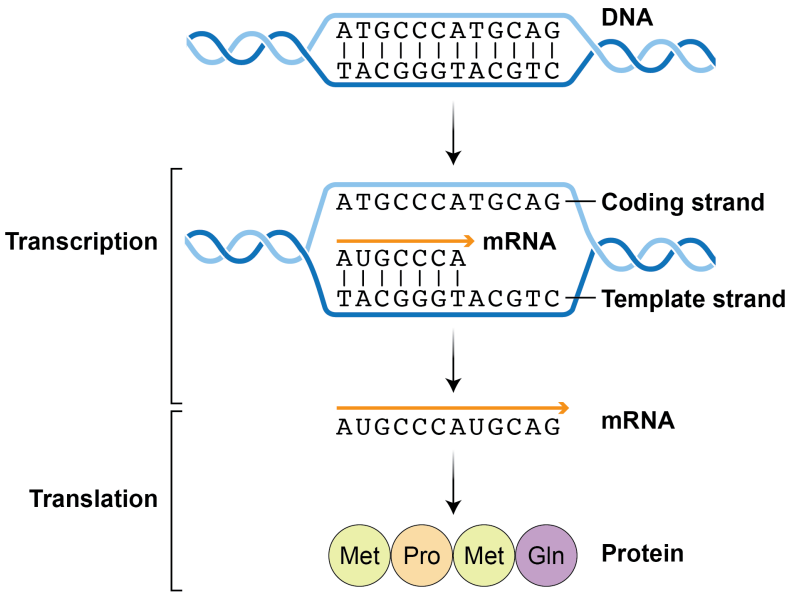

Figure 2. A summary of the processes by which genes (such as *Mc1r*) are used to make proteins (such as MC1R). First, during transcription, cells use the genetic information in DNA to create an RNA message (mRNA). Then, during translation, the mRNA is used to build a protein. The cell "reads" the mRNA sequence in groups of three nucleotides at a time, called codons. Each codon determines which amino acid is added to a growing protein.

a. Do you think there are differences between the *Mc1r* gene sequences of these mice? If yes,why?

Yes, the coloration is different. The protein resulting from the gene has changed.

b. How can changes in a DNA sequence lead to changes in an amino acid sequence?

Different codons result in different amino acid sequences. This will lead to a different protein that has an effect on fur color.

c. Based on the information throughout this activity, why would variations in a trait like fur color be important to species survival?

The variation can allow some members of the rock pocket mouse population have an advantage in natural selection. In this case, selection by predation.

PART 5: How Can Changes in DNA Result in Changes in Populations?

4. Changes in the *Mc1r* gene sequence result in rock pocket mice with different fur colors. How might a particular version of the *Mc1r* gene become more or less common in a population over time?

   If the variant (version) of the Mc1r gene develops a phenotype that helps the population survive and reproduce better than other variants (versions) of the Mc1r gene.

5. Scientists have made these observations:
   - The mouse populations that live on **light**-colored desert rocks consist mainly of mice with **light**-colored fur (and a few mice with dark-colored fur).
   - The mouse populations that live on **dark**-colored volcanic rocks consist mainly of mice with **dark**-colored fur (and a few mice with light-colored fur).

   How do you explain these observations? Make sure to discuss why the populations have individuals with *both* fur colors in different numbers.

   The Mc1r gene with the mutation for dark fur color was selected for in the dark-colored volcanic rock environment. The non-mutated gene was selected for in the light-colored desert rocks. However, individual organisms with the non-mutated gene and the mutated gene exist in both populations, they are just at a disadvantage for survival due to their coloring that stands out in the environment making it easier for predators to spot them. Because of this, there are fewer of the individual mice with the coloration that does not “fit” them to their environment.

6. Describe another example where changes in DNA may have resulted in changes in appearance among different populations of the same species.

Blood type (internal appearance) , hair color and eye color in humans

Male birds being colorful (reproductive advantage)

Dogs (all same species, mutations causing traits selected for by breeders, face shape, leg length, aggressiveness, ear shape, etc.)

Pepper moth (light and dark coloration)